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3. A comparison of the mean velocity from the sodium lines with the mean velocity from the H and K lines, the velocity of the system, and the component of solar motion is presented in the following table:

	<i>β Scorpīi</i>	<i>δ Orionis</i>
Mean velocity D ₁ and D ₂	-9.2 km.	+17.6 km.
Mean velocity H and K.....	-8.5	+18.7
Velocity of the system.....	-11.0	+15.2
Component of solar motion.....	-10.7	+18.1

4. On account of the uncertainty of the values from the oscillating lines and also in consideration of the comparatively few observations that were obtained, no attempt was made to determine a new velocity curve. Within the limits of their accuracy, our observations are satisfied by the orbits as determined at the Allegheny Observatory.

The close relationship between the D lines of sodium and the H and K lines of calcium in the two stars which have been studied is very striking. Both in appearance and in behavior these lines are entirely comparable. We have still to look for an explanation of the peculiarity in these lines. The agreement of the velocity obtained from the D lines with both the component of solar motion and the velocity of the system seem to favor equally the two principal hypotheses which have been suggested to explain the behavior of H and K; first, that the effect is caused by an absorbing cloud of calcium vapor stationary in space between the binary star and the observer; second, that its origin lies in some condition connected with the binary system, perhaps an envelop of calcium vapor around the system as a whole. These theories are as readily applicable to the D as to the H and K lines, but with no less uncertainty. At present it seems best merely to recognize the relation of the sodium and the calcium lines in the stars which have been studied and seek an explanation which will account for the peculiarity of both.

MARY LEA HEGER.

A VARIABLE STAR WITH A PECULIAR SPECTRUM

The long-period variable star R *Aquarii* 233815 has been found recently to possess a very peculiar spectrum. The data concerning this star are as follows: R. A. (1900) 23 hrs. 38.6 min.; Dec. (1900) -15°50'; Magnitude, variable, 6.2 to 11.0; Period 387.2 days; Predicted maximum 1919 Nov. 22; Spectrum Md8. The following

remarks appear in *Harvard Annals*, vol. 56, p. 212: "The spectrum varies from Md6 to Md9 on 11 plates. H δ apparently changes from 50 to 80" (H γ being assumed as 10).

A number of spectrograms recently secured with a one-prism instrument at the Cassegrain focus of the 100-inch telescope show that in addition to the characteristic features of Class Md the spectrum contains several bright nebular¹ lines. These lines appear on plates taken on the following dates:

1919	October	16
	"	17
	"	19 (by Mr. Stromberg)
	November	1 (by Mr. Adams)
	"	7
	"	9

During this period the magnitude of the star increased from 8.5 to nearly 7.

The spectrum may be described as a combination of that of a gaseous nebula with that of a typical star of Class Md. The Md spectrum closely resembles that of *α Ceti* at its last maximum, which is practically duplicated by that of many other long-period variables. A spectrogram in the red on November 9th shows that in this portion of the spectrum also, the chief features of *R Aquarii* bear a close resemblance to those of *α Ceti* as photographed on the preceding night. A bright H α line is probably present tho not so well marked as in *α Ceti*.

On the first three plates the chief nebular lines N1 and N2, and $\lambda 4363$ are very conspicuous. On the later plates they are relatively less intense, as is also the hydrogen line H β . Meanwhile H γ and especially H δ had grown stronger. Thus at this time H γ and H δ should be classed with the Md spectrum and H β with the nebular lines, tho both sources may contribute partially to all three of the lines. It is difficult to judge of the absolute intensities of the nebular lines but it appears possible that they may have remained the same while the Md spectrum grew rapidly stronger with the increase in the star's brightness. This possibility, as well as the unusual character of the spectrum, raises the question whether the source of the nebular lines is actually closely associated with that of the Md spectrum. Some other evidence on this question is now available and it is hoped that much more can be added in the next few weeks. As observed at Mt. Wilson under fair con-

¹In the Harvard telegram and *Bulletin* No. 697 the word *nebulous* should be replaced by *nebular*. The lines are not nebulous but quite sharp with one-prism dispersion.

ditions, the appearance of the object is stellar. An examination of it on November 1, by Professor Barnard, with the 40-inch telescope at Yerkes Observatory, did not disclose any true disk but showed certain focal peculiarities similar to those of novae in some of their earlier stages. Photographs by Mr. van Maanen on October 17th in the 80-ft. focus of the 60-inch with exposures of 30 sec., 3 min. and 15 min. do not show a nebular disk or any other striking peculiarity. On the spectrograms for which the star was held as nearly as possible on the center of the slit, the nebular lines do not extend farther from the center of the spectrum than do portions of the continuous spectrum (allowing for photographic effects). The radial velocities yielded by the nebular lines are about the same as those from the Md spectrum. An apparent tendency of the chief nebular lines N₁ and N₂ and H β to give algebraically greater velocities than the other bright lines, requires further investigation. To the above evidence for the identity of source of the nebular and the Md spectra may be added the consideration that if the nebular lines are derived from an object which is independent of the variable star but on the line joining it to the Earth, then such an object should have been discovered before this as a planetary nebula.

November 12, 1919.

PAUL W. MERRILL.

NOVA OPHIUCHI

Two spectrograms of the new star found by Miss Mackie and announced in the *Harvard Bulletin* No. 696, were obtained on the nights of November 1st and 2nd. The first was taken with the 60-inch telescope and 7-inch camera and the second with the 100-inch telescope and 18-inch camera, using a single prism in both cases. The star was apparently about the 9th magnitude and the exposure satisfactory.

The photograph taken with the 100-inch reflector and higher dispersion shows a large amount of detail which is yet to be examined. In general the spectrum is characteristic of new stars in the earlier stages. The bright bands of hydrogen and H and K of calcium are strong and well defined. There are many less prominent bright bands at λ 5015, 4922, 4500-4700, 4233 and perhaps others more faint. The nebular bands have not appeared. A large number of strong and easily measured absorption lines, corresponding for the most part to those in the spectrum of *a Cygni*,